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To: Yoshio Mitaku, Director-General, Patent Office

1. Title of Invention:

   Fuel cell-heat engine hybrid vehicle

2. Inventors:

   Hajime Ariga (and 1 other)
   548-14 Yukinoshita, Kamakura-shi, Kanagawa Pref.

3. Applicant:

   Nissan Motors Co., Ltd. (399)
   2 Takara-cho, Kanagawa-ku, Yokohama-shi, Kanagawa Pref.
   Representative: Katsuji Kawamata

4. Agent:

   Masaki Goto, Patent Attorney (7551)
   No. 302 Shatorenu Shinno-cho, 4-38 Minami Moto-cho, Shinjuku-ku, Tokyo
   Tel.: 357-8993

5. List of Appended Documents:

(1) Specifications 1 copy

(2) Drawings 1 copy

(3) Copy of Application 1 copy

(4) (Power of Attorney 1 copy)

Specifications

Title of Invention:

Fuel cell-heat engine hybrid vehicle

Claims:

A fuel cell-heat engine hybrid vehicle, characterized in that it is provided with both an engine and a motor driven by a fuel cell as its motive power sources, and it is constructed in such a way that only the engine ordinarily outputs [power], due to a controller which is installed in order to control their operations, but at times of high load, the motor outputs [power] in addition to the engine.

Detailed Explanation of Invention:

This invention concerns a hybrid vehicle in which both a motor driven by a fuel cell and a heat engine are installed as motive power sources.

A problem that has needed to be solved, especially in recent years, is that of atmospheric pollution by the exhaust gases of vehicles; the use of electric power in place of gasoline as the energy source has been proposed as a means of solving this problem.

Based on this idea, vehicles using fuel cells have been developed, but these fuel cells become very expensive if one tries to make their outputs large, and they become completely impractical. Up to now, therefore, high-output batteries have been provided to supplement their output, and the motor that provides the motive power source has been driven by using [the fuel cells and batteries] together.

It is an undeniable fact, however, that using this kind of construction causes a difficulty in energy supplementation, which is a problem intrinsic to battery cars.

This invention was devised in order to solve these technical problems; its purpose is to provide a novel, useful hybrid vehicle that maintains practical performance and also has a comparatively high output by providing both a fuel cell and a heat engine that supplements its output.

The technical nature of this invention will be clarified below by explaining a working example.

As shown in the drawing, this invention uses both an engine 1 and a motor 2 as the motive power sources; the motor 2 is connected in series with the engine 1, and ordinarily only the engine 1 produces an output. However, when a large output is required, the motor 2 operates together with it and causes the propeller shaft 5 to rotate, through the clutch 3 and the transmission 4.

Furthermore, the aforementioned engine 1 and the fuel cell 6 which provides power to the motor 2 are preferably formed in such a way that they share the same fuel source; a fuel cylinder 7 supplies [the fuel] to the engine 1 through a fuel pipe 8 and to the fuel cell 6 through a fuel feed pipe 9.

In this working example, a hydrogen-oxygen fuel cell is used as the fuel cell 6, and a hydrogen engine is used as the engine 1. The fuel cylinder 7 is filled with hydrogen, and the oxygen is supplied from the air.

However, the fuel cell 6 is not necessarily limited to a hydrogen-oxygen fuel cell; for example, it may also be a hydrocarbon-modified fuel cell, of course. In this case, the engine 1 may employ a hydrocarbon engine. Moreover, in order to simplify the structure, the engine 1 [in this working example] and the fuel cell 6 were given the same fuel system, but the use of an ordinary gasoline engine is also conceivable.

Next, the controller 11, which is connected to the accelerator pedal 10, controls the operations of the engine 1 and the motor 2 by adjusting the feeding of the fuel to the engine 1 and the fuel cell 6. The controller 11 is constructed in such a way that it is electrically connected to the throttle valve 12 and the solenoid valve 13, in order to adjust the fuel supplies to the engine 1 and the fuel cell 6, and the degree of opening of the accelerator pedal 10, which is inputted to the controller 11, controls only the throttle valve 12, in proportion to degrees of opening from zero up to a specific value (for example, half-open), but when the degree of opening is higher than this specific value, up to fully open, it controls the solenoid valve 13 in addition to the throttle valve 12.

Therefore, when the degree of opening of the accelerator pedal 10 is less than this specific value, only the engine 1 provides an output, and when it is greater than this value, the output of the motor 2 is added to that of the engine 1.

To explain the operation [of this working example], in addition to the structure described above, when the degree of opening of the accelerator pedal 10 is less than a specific value (for example, half-open), the solenoid valve 13 is closed by the controller 11 and only the throttle valve 12 is controlled; therefore, there is an output only from the engine 1. Therefore, in this case the motor 2, which is coaxial with the engine 1, simply idles, since no motive power is supplied from the fuel cell 6.

Moreover, when the degree of opening of the accelerator pedal 10 is greater than the specific value, the solenoid valve 13 is controlled as well as the throttle valve 12, and fuel is fed to the fuel cell 6 in proportion to the degree of opening of the accelerator

pedal. That is, when a high output is required, the output of the motor 2 is added to that of the engine 1, corresponding to the load.

In this working example, the engine 1 and the motor 2 are connected in series, but it is also possible, of course, to connect them in series. In short, the most suitable type of arrangement should be chosen, considering the problem of engine space and the other constituent members.

In sum, as is clear from the explanation given above, this invention is provided with an engine 1 and a motor 2 driven by a fuel cell 6 as the motive power source, and it is constructed in such a way that ordinarily there is only output from the engine 1, but when there is a high load, the motor 2 also provides an output, in addition to the engine 1. As a result, the exhaust of NOx is greatly reduced, compared with the case in which there is only a heat engine. Furthermore, even though fuel cells are comparatively small, they are capable of large outputs, and the feeding of the fuel can be performed comparatively easily. Therefore, a considerable effect can be expected in practice.

In addition, this invention has the effects that boost batteries are not needed, and the warming up time is shortened.

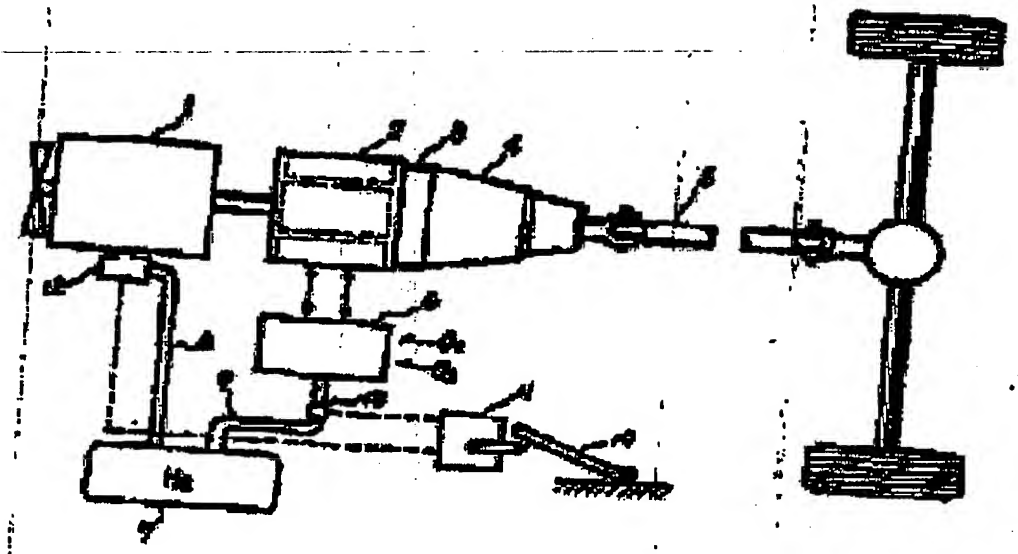
Simple Explanation of Drawing:

The drawing is an abbreviated explanatory diagram showing a working example of this invention.

1 ... Engine
2 ... Motor
6 ... Fuel cell
11 ... Controller

Applicant: Toyota Motors Co., Ltd.

Applicant: Masaki Goto, Patent Attorney



6. Inventors Other Than Those Mentioned Above:

Toshio Hirota
714 Nishi Terao, Kanagawa-ku, Yokohama-shi, Kanagawa Pref.

Amendment (Spontaneous)

April 1, 1974

To: Yoshio Mitaku, Director-General, Patent Office

1. Indication of Case:

   Application No.: 48-83385

2. Title of Invention:

   Fuel cell-heat engine hybrid vehicle

3. Person Making Amendment:

   Relationship to Case: Applicant

   Nissan Motors Co., Ltd. (399)
   2 Takara-cho, Kanagawa-ku, Yokohama-shi, Kanagawa Pref.
   Representative: Tadanori Iwakoshi

4. Agent:

   Masaki Goto, Patent Attorney (7551)
   No. 302 Shatorenu Shinno-cho, 4-38 Minami Moto-cho, Shinjuku-ku, Tokyo
   Tel.: 357-8993

5. Date of Amendment Order

6. Object of Amendment: Specifications and Drawing

7. Content of Amendment:

   The Specifications and Drawing are amended according to the attached sheets.

Specifications (Spontaneous Amendment)

Title of Invention:

Fuel cell-heat engine hybrid vehicle

Claims:

A fuel cell-heat engine hybrid vehicle, characterized in that it is provided with both an engine and a motor driven by a fuel cell as its motive power sources, and it is constructed in such a way that either the engine or the motor ordinarily outputs [power], due to a controller which is installed in order to control their operations, but at times of high load, both output [power].

Detailed Explanation of Invention:

This invention concerns a hybrid vehicle in which both a motor driven by a fuel cell and a heat engine are installed as motive power sources.

A problem that has needed to be solved, especially in recent years, is that of atmospheric pollution by the exhaust gases of vehicles; the use of electric power in place of gasoline as the energy source has been proposed as a means of solving this problem.

Based on this idea, vehicles using fuel cells have been developed, but these fuel cells become very expensive if one tries to make their outputs large, and they become completely impractical. Up to now, therefore, high-output batteries have been provided to supplement their output, and the motor that provides the motive power source has been driven by using [the fuel cells and batteries] together.

It is an undeniable fact, however, that using this kind of construction causes a difficulty in energy supplementation, which is a problem intrinsic to battery cars.

This invention was devised in order to solve these technical problems; its purpose is to provide a novel, useful hybrid vehicle that maintains practical performance and also has a comparatively high output by providing both a fuel cell and a heat engine that supplements its output.

The technical nature of this invention will be clarified below by explaining working examples.

As shown in Fig. 1, this invention uses both an engine 1 and a motor 2 as the motive power sources; the motor 2 is connected in series with the engine 1, and ordinarily only the engine 1 produces an output. However, when a large output is required, the motor 2 operates together with it and causes the propeller shaft 5 to rotate, through the clutch 3 and the transmission 4.

Furthermore, the aforementioned engine 1 and the fuel cell 6 which provides power to the motor 2 are preferably formed in such a way that they share the same fuel source; a fuel cylinder 7 supplies [the fuel] to the engine 1 through a fuel pipe 8 and to the fuel cell 6 through a fuel feed pipe 9.

In this working example, a hydrogen-oxygen fuel cell is used as the fuel cell 6, and a hydrogen engine is used as the engine 1. The fuel cylinder 7 is filled with hydrogen, and the oxygen is supplied from the air.

However, the fuel cell 6 is not necessarily limited to a hydrogen-oxygen fuel cell; for example, it may also be a hydrocarbon-modified fuel cell, of course. In this case, the engine 1 may employ a hydrocarbon engine. Moreover, in order to simplify the structure, the engine 1 [in this working example] and the fuel cell 6 were given the same fuel system, but the use of an ordinary gasoline engine is also conceivable.

Next, the controller 11, which is connected to the accelerator pedal 10, controls the operations of the engine 1 and the motor 2 by adjusting the feeding of the fuel to the engine 1 and the fuel cell 6. The controller 11 is constructed in such a way that it is electrically connected to the throttle valve 12 and the solenoid valve 13, in order to adjust the fuel supplies to the engine 1 and the fuel cell 6, and the degree of opening of the accelerator pedal 10, which is inputted to the controller 11, controls only the throttle valve 12, in proportion to degrees of opening from zero up to a specific value (for example, half-open), but when the degree of opening is higher than this specific value, up to fully open, it controls the solenoid valve 13 in addition to the throttle valve 12.

Therefore, when the degree of opening of the accelerator pedal 10 is less than this specific value, only the engine 1 provides an output, and when it is greater than this value, the output of the motor 2 is added to that of the engine 1.

To explain the operation [of this working example], in addition to the structure described above, when the degree of opening of the accelerator pedal 10 is less than a specific value (for example, half-open), the solenoid valve 13 is closed by the controller 11 and only the throttle valve 12 is controlled; therefore, there is an output only from the engine 1. Therefore, in this case the motor 2, which is coaxial with the engine 1, simply idles, since no motive power is supplied from the fuel cell 6.

Moreover, when the degree of opening of the accelerator pedal 10 is greater than the specific value, the solenoid valve 13 is controlled as well as the throttle valve 12, and fuel is fed to the fuel cell 6 in proportion to the degree of opening of the accelerator pedal. That is, when a high output is required, the output of the motor 2 is added to that of the engine 1, corresponding to the load.

Incidentally, there are cases in which it is more rational to use the fuel cell 6, unlike an ordinary battery, in such a way that a small electrical power is outputted continuously. Therefore, assuming such cases, one may also make only the motor 2 produce an output ordinarily, and make the engine 1 produce an output simultaneously at times of high load, as shown in Fig. 2.

That is, the degree of opening of the accelerator pedal 10, which is inputted to the controller 11, controls only the solenoid valve 13 and the current control circuit 14, and only the motor 2 is driven, in proportion to degrees of opening from zero up to a specific value (for example, half-open), but when the degree of opening is higher than this specific value, up to fully open, the throttle valve 12 is also controlled, and the engine 1 operates and provides an output at the same time.

The aforementioned current control circuit 14 is installed in order to control the current fed from the fuel cell 6 to the motor 2. Of course, it is also possible to use a type in which, as in the aforementioned Working Example 1, the flow rate of the fuel fed to the fuel cell 6 is controlled by the solenoid valve 13 and this output current is adjusted, but both were provided in order to increase the reliability of the control.

Furthermore, when only the motor 2 rotates and provides an output, the engine 1 is allowed to idle, but in this case, one may feed the quantity of fuel needed to kkeep engine braking from being applied.

In the working examples mentioned above, the engine 1 and the motor 2 are connected in series, but it is also possible, of course, to connect them in series. In short, the most suitable type of arrangement should be chosen, considering the problem of engine space and the other constituent members.

In sum, as is clear from the explanation given above, this invention is provided with an engine 1 and a motor 2 driven by a fuel cell 6 as the motive power source, and it is constructed in such a way that ordinarily there is only output from the engine 1, but when there is a high load, the motor 2 also provides an output, in addition to the engine 1. As a result, the exhaust of NOx is greatly reduced, compared with the case in which there is only a heat engine. Furthermore, even though fuel cells are comparatively small, they are capable of large outputs, and the feeding of the fuel can be performed comparatively easily. Therefore, a considerable effect can be expected in practice.

In addition, this invention has the effects that boost batteries are not needed, and the warming up time is shortened.

Simple Explanation of Drawing:

The drawings show working examples of this invention. Fig. 1 is an abbreviated explanatory diagram showing a first working example of this invention, and Fig. 2 is an explanatory diagram of a second working example..

1 ... Engine

2 ... Motor

6 ... Fuel cell

11 ... Controller

12 ... Throttle valve

13 ... Solenoid valve

14 ... Current control circuit

Fig. 1

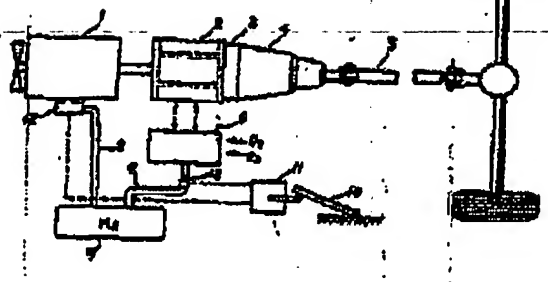
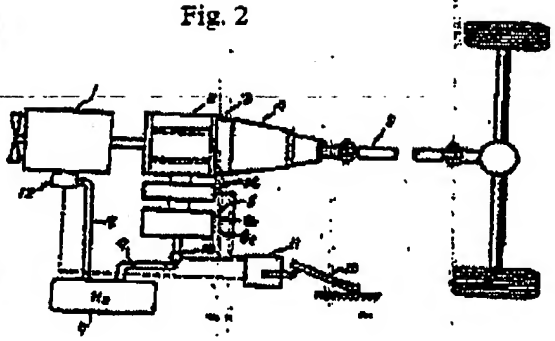


Fig. 2



TRANSLATOR CERTIFICATION

450 7th Ave | 6th Floor | New York, NY 10123 | Tel 212.643.8800 | Fax 212.643.0005 | www.mside.com

Morningside | Translations

I, Jon Johanning, a translator fluent in the Japanese language, on behalf of Morningside Evaluations and Consulting, do solemnly and sincerely declare that the following is, to the best of my knowledge and belief, a true and correct translation of the document(s) listed below in a form that best reflects the intention and meaning of the original text.

MORNINGSIDE EVALUATIONS AND CONSULTING

Jon Johanning

Signature of Translator

Date: May 25, 2005

Description of Documents Translated: Fuel cell-heat engine hybrid vehicle